



FAME Safety

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System Safety Program



- **FAME System Safety Program**
 - **Identify & Control Risks & Hazards Inherent In the Space Vehicle Design, Test, Processing, & Launch Operations**
 - **Assure That FAME Space Vehicle Design, Assembly, Test, Transportation, Processing & Launch Is Accomplished According to KSC, ER , and NRL Safety Requirements**
- **FAME Safety Organization**
 - **FAME Safety Manager**
 - **Coordination & Integration of Space Vehicle Safety Activities**
 - **Interface With Instrument Safety Engineer**
 - **Key Interface to External Safety Organizations**
 - **NASA (GSFC and KSC)**
 - **Eastern Range**
 - **During Field Operations, Receive Work Direction & Authority Directly From the NRL FAME Program Manager**



Safety Technical Requirements



- **Ground Safety**

- **NRL**

- **NRLINST 5100.13D, 13 March 2001, "NRL Safety and Occupational Health Manual"**
 - **NRLINST 8020.1D, 26 March 1999, "NRL Explosives Safety Manual"**
 - **NRLINST 5100.11F, 10 February 1997, "NRL Radiation Protection Manual"**

- **KSC**

- **Design Requirements**
 - **FAME Tailored EWR 127-1 (Within FAME SSPP, NCST-D-FM010)**
 - **Ground Operational Requirements**
 - **KHB 1710.2D, "Kennedy Space Center Safety Practices Handbook"**

- **ER**

- **Design Requirements**
 - **FAME Tailored EWR 127-1 (Within FAME SSPP, NCST-D-FM010)**
 - **Ground Operational Requirements**
 - **KHB 1710.2D, "Kennedy Space Center Safety Practices Handbook"**



Safety Documentation and Reviews



- **FAME Safety Review Process and FAME Safety Documentation Will Meet the Intent Of: MINDEX Safety, Reliability, & Quality Assurance Plan, GSFC-410-MINDEX-003**
 - GSFC-410-MINDEX -002, MINDEX Assurance Requirements
 - Section 4.0 “Safety” Except Section 4.1c (Not Applicable)
 - Detailed in FAME System Safety Program Plan (SSPP), NCST-D-FM010
- **FAME Ground Hazard Report Cover Sheet Details the Ground Hazard Report Number/date/revision, Title, Ground Affected Phases, Probability/Severity Codes, SAR Reference Sections, and Background**
 - Template Presented Later in This Presentation
- **FAME Ground Hazard Report Information Details the Causes, Controls, and Methods of Verification**
- **FAME Ground Hazard Reports Will Be Signed Off at Final Safety Review With Hazard Report Closure Logs Open for Those Verifications Being Closed After the Final Safety Review (Mostly During FAME Field Operations)**
 - Template Presented Later in This Presentation
- **FAME Phase Safety Reviews and Safety Documentation Submittals Are Detailed Later in This Presentation**



Safety Reviews, WGs, TIMs and Tabletops



- **FAME Program Introduction to KSC/ER Soon After Confirmation Process Completed**
- **Safety Reviews**
 - **GSFC**
 - **None Planned, GSFC Will Attend KSC/ER Safety Reviews**
 - **KSC/ER**
 - **Preliminary Review Around CDR**
 - **Final Review Prior to Pre-ship Review**
- **Safety Working Groups/TIMs**
 - **GSFC**
 - **As Required**
 - **Two Have Occurred (10/03/01 and 10/17/01)**
 - **KSC/ER**
 - **As Required to Support GOWG**
- **Ground Procedure Tabletops**
 - **Only With KSC/ER (GSFC Will Request Procedures to Review)**



Safety Documentation (1 of 2)



- **FAME Prepared Safety Documentation**
 - **FAME Safety Assessment Reports (SARs) (Pre-Submittal Review by GSFC)**
 - Preliminary
 - Final
 - Used as Input to Final LV MSPSP
 - Post-Launch (Incorporate Signed HRs, As-Run Procedure List/Grd Flow)
 - **FAME System Safety Program Plan (SSPP)**
 - **Materials Usage Lists (Meet Approved Materials Lists (Ground and Mission))**
 - **Safety Equipment Approvals (MAGE and EAGE - Hand-Held and Powered)**
 - **FAME SAEF-2 Safety Plan**
 - **FAME Inputs to Launch Site Safety Plan**
 - **FAME Waste Reports to KSC**
- **FAME Safety Inputs to FAME Documentation**
 - **FAME Transportation Plan**
 - **FAME Field Procedures**
 - **FAME Training Plan**
 - **FAME FMEAs**



Safety Documentation (2 of 2)



- **FAME Preliminary Hazard Analysis (PHA)**
 - **Complies with MIL-STD-882D**
 - **Format & Content Complies With Data Item Description DI-SAFT-80101B**
 - **Preliminary Information for FAME PHA Reviewed With GSFC Safety on 10/17/01**
- **FAME Safety Assessment Report (SAR)**
 - **Format and Content Complies With:**
 - **EWR 127-1 Appendix 3A**
 - **Data Item Description DI-SAFT-80102B**
- **FAME System Safety Program Plan (SSPP)**
 - **Format and Content Complies With EWR 127-1 Appendix 1B**
 - **FAME SSPP in Work (Need Information From KSC/ER)**
 - **EWR 127-1 Chapter 1 Compliance Matrix and Preliminary EWR 127-1 Chapter 3 Compliance Matrix Provided to GSFC Safety on 10/10/01**
 - **Reviewed Questions From GSFC Safety on 10/17/01**
 - **EWR 127-1 Chapter 6 Compliance Matrix in Work**



FAME Ground Hazard Report Titles (For Space Vehicle) (1 of 2)



- **GHR 1: Leakage/Rupture/Explosion of Propellant or Pressurant Systems**
- **GHR 2: Inadvertent Ordnance Activation**
- **GHR 3: Structural Failure and/or Collision During Lift / Handling / Transport**
- **GHR 4: Flammable Materials / Ignition Sources**
- **GHR 5: Inadvertent Thruster Firing**
- **GHR 6: Inadvertent Release of Hazardous Materials Causing Personnel Exposure / Injury**
- **GHR 7: Inadvertent RF Transmission (Exposure of Personnel)**



FAME Ground Hazard Report Titles (For Space Vehicle) (2 of 2)



- **GHR 8: Exposed Electrical Systems Resulting in Personnel Injury / Shocks / Burns**
- **GHR 9: Battery Rupture / Leakage / Explosion**
- **GHR 10: Inadvertent Mechanism Release / Deployment**
 - **Includes Instrument Door**
- **GHR 11: Personnel Injury Due to Human Factors or Improper Operations**



Hazards, Hazard Causes & Hazard Controls



- **Hazards Identified**
 - Detailed by Ground Hazard Report Title
 - Refer to Previous 2 Slides
 - Refer to Backup Slides
- **Hazard Causes Identified**
 - Refer to Backup Slides
- **Hazard Controls In Work**
 - Will Be Identified in Preliminary Safety Assessment Report



FAME Ground Hazard Report Template



GROUND Hazard Report			
Hazard # <u>Number</u>		Title: _____ _____ _____ _____	
Date	Revision		
Closure Concurrence All verifications were certified by the FAME Safety Manager.			
<u>FAME Safety Mgr</u> FAME Safety Mgr (date)		<u>FAME Program Manager</u> FAME Program Manager (date)	<u>SRP Co-Chairman1</u> SRP Co-Chairman (date)
		<u>SRP Co-Chairman2</u> SRP Co-Chairman (date)	
Probability and Severity Codes	Ground Affected Phases	System/Subsystem	Background
	<input type="checkbox"/> Phase 1: RCS MAGE Arrival <input type="checkbox"/> Phase 2: Fill Fuel Propellant Service Trailer <input type="checkbox"/> Phase 3: SRM Arrival and Processing <input type="checkbox"/> Phase 4: Transport ISA, MAGE, EAGE, ELSE to PPF <input type="checkbox"/> Phase 5: Checkout EAGE/ELSE and Checkout ISA <input type="checkbox"/> Phase 6: SRM/ISA Mate and SRM/ISA Spin Balance <input type="checkbox"/> Phase 7: Transport S/C & MAGE to PPF and Off-Load <input type="checkbox"/> Phase 8: Checkout S/C and Instrument <input type="checkbox"/> Phase 9: S/C Battery Charging <input type="checkbox"/> Phase 10: Weigh FAME S/C (Dry) <input type="checkbox"/> Phase 11: Prepare FAME for Propellant Load <input type="checkbox"/> Phase 12: Load Propellant and Pressurize Tanks <input type="checkbox"/> Phase 13: Post-Prop Loading/Pre-Integration Ops <input type="checkbox"/> Phase 14: Spacecraft/ISA Integration <input type="checkbox"/> Phase 15: Post Spacecraft/ISA Integration Ops <input type="checkbox"/> Phase 16: Spacecraft Spin Balance <input type="checkbox"/> Phase 17: Install Red tag Items <input type="checkbox"/> Phase 18: Weight FAME Space Vehicle <input type="checkbox"/> Phase 19: Post-Weigh Operations <input type="checkbox"/> Phase 20: Space Vehicle Functional Checkout <input type="checkbox"/> Phase 21: Transport ELSE to Pad & Checkout <input type="checkbox"/> Phase 22: Weight SV/Mate to 3rd Stage/Encapsulate <input type="checkbox"/> Phase 23: aTransport to Pad, Install onto Delta <input type="checkbox"/> Phase 24: Post-Install Testing/Red Tag Removal <input type="checkbox"/> Phase 25: Battery Charging <input type="checkbox"/> Phase 26: Install Arm Plugs <input type="checkbox"/> Phase 27: Ordnance Operations <input type="checkbox"/> Phase 28: Launch Operations <input type="checkbox"/> Phase 29: Post-Launch Cleanup & Transport	SAR Reference Sections	



FAME Ground Hazard Report Closure Log Template



	HC 1.1.11	HC 1.1.12	HC 1.1.14	HC 1.2.7	HC 1.3.3	HC 1.4.1
	LITHIUM BATTERY	DURING HIGH RATE CHARGE,	HANDLING DOLLY CHECKED	TANK BLANKET	VACUUM CART	S/C ELECTRICAL
	TEMP/PRESSURE	ELSE WILL LIMIT OVERCHARGE	OUT PRIOR TO USE	PRESSURE	IS USED	COMPONENTS NOT
PROCEDURE	MONITORED BY ELSE	OF BATTERY		MONITORED	PROPERLY	POWERED (EXCEPT FOR TRANSDUCERS)
SOP-OR-FM001	N/A	N/A	N/A	N/A	N/A	V.1.1
SOP-MG-FM001	N/A	N/A	N/A	N/A	N/A	N/A
TOP-EE-FM002	N/A	N/A	N/A	N/A	N/A	N/A
TOP-EE-FM004	V.3.6; V.4.9; V.5.4	Note - Page 16	N/A	N/A	N/A	N/A
TOP-ME-FM001 T2	N/A	N/A	V.1.2.3	N/A	N/A	N/A
TOP-ME-FM001 T4	N/A	N/A	V.6.1.1	N/A	N/A	N/A
TOP-RC-FM001	N/A	N/A	N/A	V.2.0	Sction V	N/A
TOP-RC-FM008	N/A	N/A	N/A	N/A	N/A	VERIFIED
TOP-RC-FM010	N/A	N/A	N/A	N/A	N/A	VERIFIED
TOP-RC-FM012	N/A	N/A	N/A	N/A	N/A	VERIFIED
TOP-OR-FM003	N/A	N/A	N/A	N/A	N/A	V.1.2.9
TOP-OR-FM004	N/A	N/A	N/A	N/A	N/A	V.2.1.6
TOP-OR-FM005	N/A	N/A	N/A	N/A	N/A	V.2.1.4
TOP-OR-DS007	N/A	N/A	N/A	N/A	N/A	V.2.1.3
TOP-OR-FM008 T2	N/A	N/A	N/A	N/A	N/A	V.1.1.4
TOP-OR-FM008 T3	N/A	N/A	N/A	N/A	N/A	V.1.1.4
TOP-OR-FM008 T4	N/A	N/A	N/A	N/A	N/A	V.1.1.4
TOP-OR-FM010	N/A	N/A	N/A	N/A	N/A	V.2.1.6
TOP-IG-FM003	N/A	N/A	N/A	N/A	N/A	V.2.1.4

TEMPLATE



Safety Workload



- **Safety Oversight**
 - **FAME Factory Operations**
 - **Part of Review Cycle for FAME Documentation & Drawings**
 - **Approval Authority for All FAME Ground Procedures**
 - **FAME POC to NRL Safety for FAME KSC/ER Operations**
 - **Attend FAME Buyoffs**
 - **FAME KSC Operations**
 - **FAME Transportation, SAEF-2 and Pad Operations**
 - **Perform Site Surveys and Walkdowns of Facility and Pad**
 - **Monitor Mods (If Applicable)**
 - **Attend FAME Buyoffs**
 - **Conduct or Attend Procedures' Pre-task Briefings**
 - **Participate in All Hazardous Procedures**
- **Manage All Training of FAME Personnel for KSC/ER Operations**



Field Processing Ground Rules



- **FAME Processing in One Facility Only**
 - Therefore Serial Flow
- **FAME Processing in SAEF-2 (for Planning Purposes Only)**
 - Have Not Completed a Walkdown to Know If Any “Issues” With SAEF-2
 - Will Probably Occur When at KSC for Program Introduction
- **NRL Performing Propellant Loading at KSC**
 - Therefore NRL Propellant Service Carts
 - At Program Introduction Will Request Quote From KSC for KSC to Perform Propellant Loading
- **FAME AKM Shipped Directly to KSC (or to CCAS FSA-2 for Storage)**
- **FAME AKM Inspection and Checkout at SAEF-2**
- **FAME Flight Hardware Transported By Truck to KSC**
- **FAME PC-72s Transported By Truck to CCAS FSA-2 for Storage**
- **FAME PC-72s’ Inspection and Checkout at CCAS FSA-2 (Off-line)**
- **FAME Red Tag Removals and Access to Spacecraft Completed Prior to Fairing Installation**
 - Except Contingency Operations



FAME Hazardous Operations



- **Propellant Loading (CCAS Fuel Farm (FSA-1) & SAEF-2)**
- **Propellant Transfer Operations (CCAS Fuel Farm (FSA-1) & SAEF-2)**
- **Pressurization (SAEF-2)**
 - **FAME Contains the Following Pressurized System Upon Arrival to KSC**
 - **EPS (Lithium Ion Battery)**
 - **FAME Undergoes the Following Pressurization Operations at KSC**
 - **PSC Checkout**
 - **RCS Flight Hardware Checkout and Tank Cover Pressure**
- **SRM Checkout (SAEF-2)**
- **Ordnance Testing of S/C (SAEF-2 & Pad)**
- **Checkout of Interstage Marman Clamp Ordnance (SAEF-2 or FSA-2)**
- **Solar Array Illumination Test (SAEF-2)**
- **Lifting Operations (SAEF-2) (Flight Hardware and AGE)**
- **Mating Operations (SAEF-2)**
- **Battery Charging (SAEF-2 & Pad)**
- **Install/Remove GN2 Purges (SAEF-2 & Pad)**
- **SRM/ISA Spin Balance and Space Vehicle Spin Balance (SAEF-2)**
- **Spin Balance Machine Calibration and Spin Fixture Balance (SAEF-2)**



FAME Flight Hardware Hazardous Commodities



- **RCS:**
 - Hydrazine Loaded at KSC (110 Lbs Max in One 19 Inch Tank) (Approx 13 Gallons)
 - Gaseous Helium Loaded at KSC (Approx 0.2 Lbs at 415 Psia)
 - RCS Pyro Valves On Board When Arrive At KSC
 - Star 30BP Motor and Initiator Inspected, Undergoes Checkout, Handled and Integrated at KSC
 - PC-72 Cartridges for Interstage Marman Clamp Inspected and Installed at KSC
- **EPS: Onboard When Arrive at KSC**
 - Lithium Ion Battery (One 35 Ah) On Board When Arrive at KSC
- **Mechanisms:**
 - Interstage Marman Clamp Kickoff Springs Installed at KSC
 - Six Release Mechanisms Installed at KSC (Pin-Pullers) (Controlled by FAME OCS)
 - Three to Release Trim Tabs
 - Three to Release Trim Areas
 - Paraffin Actuators for Instrument Door (Actuated at KSC/ER) (Bus Provides Control)



FAME Hazardous Materials Used at KSC (1 of 3)



- **Materials Used on the FAME Program at KSC**
 - **Acetone**
 - **Small Amounts of Acetone Used to Clean Surfaces for Thermal Blanket Installation**
 - **Alumalloy**
 - **TCS**
 - **Braycote 600, 601, and 602**
 - **Lubricant of Release Bolts and Fasteners**
 - **Ethyl Alcohol**
 - **Clean FAME Solar Arrays (Silver Teflon)**
 - **Helium, Gaseous**
 - **Used for Operations Involving Propellant Transfer and Pressurization of the FAME High Pressure Tanks**



FAME Hazardous Materials Used at KSC (2 of 3)



- **Materials Used on the FAME Program at KSC and Provided to FAME by KSC**
 - **Hydraulic Fluid(?)**
 - **Assembly Dolly Hydraulic System**
 - **Hydrazine**
 - **Liquid Propellant**
 - **Isopropyl Alcohol**
 - **Solvent to Flush Contaminated MMH RCS Loading Equipment**
 - **Clean FAME Structure**
 - **Clean FAME Solar Arrays**



FAME Hazardous Materials Used at KSC (3 of 3)



- **Materials Used on the FAME Program at KSC and Provided to FAME by KSC**
 - **Kapton Tape**
 - **TCS Blankets**
 - **Krytox 240 AC**
 - **Used Sparingly as a Lubricant in the RCS Subsystem**
 - **Nitrogen, Gaseous**
 - **Instrument Purge**
 - **Startracker Purge**
 - **Nitrogen, Liquid**
 - **Used in the Vacuum Cart Cold Trap**



FAME Plastic Covers and Storage Containers



- **Herculite 80**
 - **Covers for Outside Storage of RCS Service Equipment**
- **RCAS 2400**
 - **Storage Bags for Hydrazine Parts and Related Equipment**
- **RCAS 1206**
 - **Thruster Nozzle Covers**
- **ABS Plastic**
 - **Tank Covers (Remove Before Flight)**
- **Plastic**
 - **Dust Covers for Connectors (Remove Before Flight)**



Open Items To Be Resolved With KSC/ER



- **Safety Management**
 - **FAME SSPP Open Items (Safety Organization Charts, Flow Charts, Safety Reviews (How Many, Where At), etc)**
- **Safety Design Requirements**
 - **EWR 127-1 Tailoring**
- **Safety Documentation**
 - **Definitization of What is Required, Delivery Schedule**
- **FAME Processing Facility(ies) at KSC**
 - **One or Two Facilities (Process SRM in series or parallel?)?**
 - **Walkdown of SAEF-2 to Verify Meets FAME Processing Requirements**
 - **Spin Balance Machine for SRM/ISA Spin Balance & SV Spin Balance**



Back-Up



Safety Documentation and Safety Review Requirements (1 of 2)

- **FAME Safety Review Process and FAME Safety Documentation Will Meet or Exceed: FAME Tailored EWR 127-1**
 - **Section 1.5.4 “Documentation and Activity Requirements”**
 - **Section 1.6 “Range Safety and Range User Interface Process”**
 - **Section 1.7 “Range Safety Concept to Launch Process”**
 - **Appendix 1A “The EWR 127-1 Tailoring Process”**
 - **Appendix 1B “System Safety Program Requirements”**
 - **Appendix 1C “Submitting EWR 127-1 Noncompliance Reports”**
 - **Appendix 1E “Making Changes to 127-1”**
 - **Appendix 1F “Generic Payload Policy and Approval Requirements”**
 - **Appendix 1G “Launch Complex Safety Training and Certification”**



Safety Documentation and Safety Review Requirements (2 of 2)



- **FAME Safety Review Process and FAME Safety Documentation Will Meet or Exceed: FAME Tailored EWR 127-1 (Continued)**
 - **Section 3.3 “General Design Policy”**
 - **Section 3.4 “Documentation Requirements”**
 - **Appendix 3A “Missile System Prelaunch Safety Package”**
 - **Section 6.2.3.4 “Document Preparation and Maintenance”**
 - **Section 6.4 “Documentation Requirements”**
 - **Section 6.4 “Ground Operations General Requirements”**
 - **Section 6.10.3 “Hazardous Materials Procedures”**
 - **Section 6.11.3 “Ground Support Pressure Systems Procedures”**
 - **Section 6.14.3 “Electrical Systems Procedures”**
 - **Section 6.14.6.3 “Battery Procedures”**
 - **Section 6.16.1 “Convoy Transportation Procedures”**
 - **Appendix 6A “Ground Operations Plan”**
 - **Appendix 6B “Hazardous and Safety Critical Procedure Requirements”**



FAME Ground Phases (1 of 2)



- **FAME Ground Phase 1: RCS MAGE Arrival (Approximately 1 Month Prior to FAME Arrival)**
- **FAME Ground Phase 2: Fill Fuel Propellant Service Trailer**
- **FAME Ground Phase 3: SRM Arrival and Processing**
- **FAME Ground Phase 4: Transport ISA, MAGE, EAGE, & ELSE to PPF and Off-Load**
- **FAME Ground Phase 5: Checkout EAGE/ELSE and Checkout ISA**
- **FAME Ground Phase 6: SRM/ISA Mate and SRM/ISA Spin Balance**
- **FAME Ground Phase 7: Transport S/C & MAGE to PPF and Off-Load**
- **FAME Ground Phase 8: Checkout S/C and Instrument**
- **FAME Ground Phase 9: S/C Battery Charging**
- **FAME Ground Phase 10: Weigh FAME S/C (Dry)**
- **FAME Ground Phase 11: Prepare FAME for Propellant Load**
- **FAME Ground Phase 12: Load Propellant and Pressurize Tanks**
- **FAME Ground Phase 13: Post-Prop Loading / Pre-Integration Operations**
- **FAME Ground Phase 14: Spacecraft/ISA Integration**



FAME Ground Phases (2 of 2)



- **FAME Ground Phase 15: Post Spacecraft/ISA Integration Operations**
- **FAME Ground Phase 16: Spacecraft Spin Balance**
- **FAME Ground Phase 17: Install Red Tag Items**
- **FAME Ground Phase 18: Weigh FAME Space Vehicle**
- **FAME Ground Phase 19: Post-Weigh Operations**
- **FAME Ground Phase 20: Space Vehicle Functional Checkout**
- **FAME Ground Phase 21: Transport ELSE to Pad & Checkout**
- **FAME Ground Phase 22: Weigh SV/Mate to 3rd Stage/Encapsulate**
- **FAME Ground Phase 23: Transport to Pad, Install Onto Delta**
- **FAME Ground Phase 24: Post-Install Testing/Red Tag Removal/Cleaning**
- **FAME Ground Phase 25: Battery Charging**
- **FAME Ground Phase 26: Install Arm Plugs**
- **FAME Ground Phase 27: Ordnance Operations**
- **FAME Ground Phase 28: Launch Operations**
- **FAME Ground Phase 29: Post-Launch Cleanup & Transport**



FAME Details on Ground Phases (1 of 5)



- **FAME Ground Phase 1**
 - **RCS MAGE Arrival (Approximately 1 Month Prior to FAME Arrival)**
 - **Fuel Propellant Service Cart**
 - **Pressurant Control Console**
- **FAME Ground Phase 2**
 - **Fill Fuel Propellant Service Trailer**
- **FAME Ground Phase 3**
 - **SRM Arrival, Unload SRM at PPF, SRM Premating Processing (Inspection), SRM Premating Processing (Thermal), Place SRM in Corner/Out of Way**
- **FAME Ground Phase 4**
 - **Transport ISA, MAGE, EAGE and ELSE and Unload in PPF**
- **FAME Ground Phase 5**
 - **EAGE/ELSE Checkout, ISA Electrical Functional Checkout**
- **FAME Ground Phase 6**
 - **Spin Balance Machine C/O, SRM to ISA Mating, SRM/ISA Spin Balance**
- **FAME Ground Phase 7**
 - **Unload S/C and MAGE in PPF, MAGE Setup and C/O, Setup Spacecraft**



FAME Details on Ground Phases (2 of 5)



- **FAME Ground Phase 8**
 - **Spacecraft & Instrument Walkdown, S/C Electrical Functional Checkout, Network Integration Test, GNC Test, Compatibility Test, Star Tracker Test, Software Testing, ACS/RCS Electrical Functional**
- **FAME Ground Phase 9**
 - **S/C Battery Charging**
- **FAME Ground Phase 10**
 - **Weigh S/C (Dry)**
- **FAME Ground Phase 11**
 - **Preps for Spacecraft Propellant Loading, Remove Purges, Transport PSCs to PPF**
- **FAME Ground Phase 12**
 - **Spacecraft Fueling Ops & Cleanup**
- **FAME Ground Phase 13**
 - **Transfer PSCs to CCAS Fuel Farm, RCS Thermal Closeout, Post-Fueling Power On Checkout, SC Solar Array Illumination Test, Separation Ordnance Checkout**



FAME Details on Ground Phases (3 of 5)



- **FAME Ground Phase 14**
 - **Spacecraft and ISA Integration, Install Kickoff Springs, Connect Separable Connectors**
- **FAME Ground Phase 15**
 - **SC/ISA Thermal Closeout, Spacecraft End-To-End RF Compatibility Test0**
- **FAME Ground Phase 16**
 - **Spin Balance Machine C/O, Spacecraft Spin Balance**
- **FAME Ground Phase 17**
 - **Install Red Tag Items (Including Purges)**
- **FAME Ground Phase 18**
 - **Lift/Weigh S/V (Wet)**
- **FAME Ground Phase 19**
 - **Ordnance Safe Check, Ordnance Checks, Cable for SV Functionals**
- **FAME Ground Phase 20**
 - **SV Functionals**
- **FAME Ground Phase 21**
 - **Transport ELSE to Pad, Setup, Tower Umbilical Test, Combined System Test**



FAME Details on Ground Phases (4 of 5)



- **FAME Ground Phase 22**
 - **LV Weigh SV, Mate LV 3rd Stage to SV, Encapsulate for Transport to Pad, Integrate SV to Delta 3rd Stage, Install SV/Delta 3rd Stage to Transport Can**
- **FAME Ground Phase 23**
 - **Transport S/V, S/V Mate, Install SV Purge**
- **FAME Ground Phase 24**
 - **Connect Umbilical, Umbilical Functional, Pre-Mate Ordnance Safe Check, Red Tag Removal, Remove Solar Array Covers, Clean Solar Arrays, SV Health Checks**
- **FAME Ground Phase 25**
 - **Battery Charging (Approximately 7 Days Prior to Launch)**
 - **High Charge Rate Approximately 15 Hours**
 - **ELSE at Pad Manned (Contingency Power Down)**
 - **Spacecraft Manned (Contingency Install EPS Safe Plug)**
 - **Trickle Charge Up to Launch**



FAME Details on Ground Phases (5 of 5)



- **FAME Ground Phase 26**
 - **Install EPS Arm Plugs (Solar Arrays, Battery), Blanket Closeout, Remove SV Purge/Star Tracker Cover, SV Health Checks, SV Battery Trickle Charge**
- **FAME Ground Phase 27**
 - **OCS Tests, OCS Arm Plug Install, Blanket Closeout, SV Walkdown, Pull S&A Pin, SV Health Checks, SV Battery Trickle Charge**
- **FAME Ground Phase 28**
 - **Launch Operations, SV Health Checks, SV Battery Trickle Charge, T-15 min Arm SV SRM**
- **FAME Ground Phase 29**
 - **Post-Launch Cleanup of PSCs, Transport all FAME MAGE, EAGE, RCSMAGE, OCSMAGE, etc off of KSC/ER**



Hazard Causes in Ground Hazard Reports (1 of 5)



- **GHR 1 Leakage/Rupture/Explosion of Propellant or Pressurant Systems**
 - **Hazard Cause 1.0: Inadequate Strength / Design**
 - **Hazard Cause 2.0: Corrosion, Wear, Abuse, or Physical Damage in Manufacturing or Handling**
 - **Hazard Cause 3.0: Mechanical Damage in Manufacturing or Handling**
 - **Hazard Cause 4.0: Improper Installation/Assembly**
 - **Hazard Cause 5.0: Operator Error**
 - **Hazard Cause 6.0: Mechanical Component Failure**
- **GHR 2 Inadvertent Ordnance Activation**
 - **Hazard Cause 1.0: Electrical Component Failure**
 - **Hazard Cause 2.0: Static Discharge / EMI / Lightning Induces EED Firing**
 - **Hazard Cause 3.0: Operator Error During Ordnance Operations**
 - **Hazard Cause 4.0: Mechanical Component Failure**



Hazard Causes in Ground Hazard Reports (2 of 5)



- **GHR 3 Structural Failure and/or Collision During Lift / Handling / Transport**
 - **Hazard Cause 1.0: Inadequate Strength / Design**
 - **Hazard Cause 2.0: Corrosion, Wear, Abuse, or Physical Damage**
 - **Hazard Cause 3.0: Propagation of Crack-Like Defects**
 - **Hazard Cause 4.0: Improper Installation / Use**
 - **Hazard Cause 5.0: Operator Error**
 - **Hazard Cause 6.0: Electrical Component Failure**
- **GHR 4 Flammable Materials / Ignition Sources**
 - **Hazard Cause 1.0: Electrical Shorts / Arcing / Sparking**
 - **Hazard Cause 2.0: Excess Flammable Materials**
 - **Hazard Cause 3.0: Material Incompatibility**
 - **Hazard Cause 4.0: Smoking or Open Flames**
- **GHR 5 Inadvertent Thruster Firing**
 - **Hazard Cause 1.0: Component Failure**
 - **Hazard Cause 2.0: Inadvertent Commands to Operate**



Hazard Causes in Ground Hazard Reports (3 of 5)



- **GHR 6 Inadvertent Release of Hazardous Materials Causing Personnel Exposure / Injury**
 - **Hazard Cause 1.0: Mechanical Component Failure**
 - **Hazard Cause 2.0: Inadequate Personnel Protection**
 - **Hazard Cause 3.0: Improper Handling / Operator Error**
- **GHR 7 Inadvertent RF Transmission (Exposure of Personnel)**
 - **Hazard Cause 1.0: Operator Exceeds RF Safe Distance**
 - **Hazard Cause 2.0: Operator Error**
 - **Hazard Cause 3.0: RF Frequencies Not Approved by KSC**
- **GHR 8 Exposed Electrical Systems Resulting in Personnel Injury / Shocks / Burns**
 - **Hazard Cause 1.0: Exposed / Accessible Terminals and Circuitry**
 - **Hazard Cause 2.0: Inadequate / Improper Design**



Hazard Causes in Ground Hazard Reports (4 of 5)



- **GHR 9 Battery Rupture / Leakage / Explosion**
 - **Hazard Cause 1.0: Internal / External Short**
 - **Hazard Cause 2.0: Overcharge**
 - **Hazard Cause 3.0: Cell Reversal or Overdischarge**
 - **Hazard Cause 4.0: Overtemperature**
 - **Hazard Cause 5.0: Leakage**

- **GHR 10 Inadvertent Mechanism Release / Deployment**
 - **Hazard Cause 1.0: Component Failure**
 - **Hazard Cause 2.0: Inadequate Strength/Design**
 - **Hazard Cause 3.0: Inadvertent Commands to Operate**



Hazard Causes in Ground Hazard Reports (5 of 5)



- **GHR 11: Personnel Injury due to Human Factors or Improper Operations**
 - **Hazard Cause 1.0: Human Error**
 - **Hazard Cause 2.0: Inadequate Operations and Maintenance Procedures and Training**
 - **Hazard Cause 3.0; Inadequate Noise Protection**
 - **Hazard Cause 4.0: Sharp Edges/Protrusions**
 - **Hazard Cause 5.0: Inaccessibility of Hardware**
 - **Hazard Cause 6.0: Moving/rotating equipment**
 - **Hazard Cause 7.0: Extreme Temperatures**
 - **Hazard Cause 8.0: Inadequate Safety Equipment**
 - **Hazard Cause 9.0: Personnel Injury Due to High Power**
 - **Hazard Cause 10.0: Cables or Other Electrical/Pressure Equipment Create Trip, Snag, and Whipping Hazards**